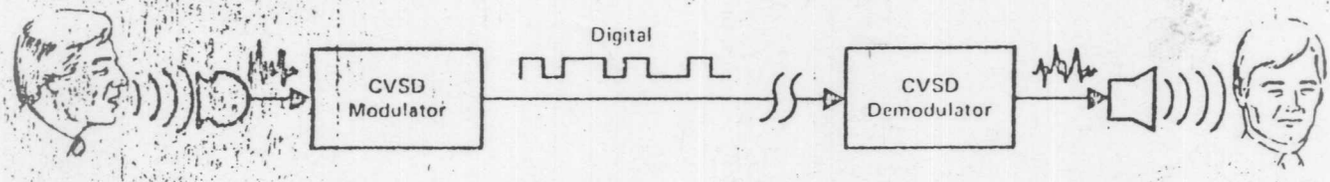
HARRIS SEMICONDUCTOR
A DIVISION OF HARRIS CORPORATION

CVSD
Concept and Operations

What is CVSD?

This stands for Continuously Variable Slope Delta Modulation.

Fundamentally it is a means for converting a voice signal into a digital data stream; and reconverting that data stream back into the analog voice signal:



Why Transform Voice into Digital?

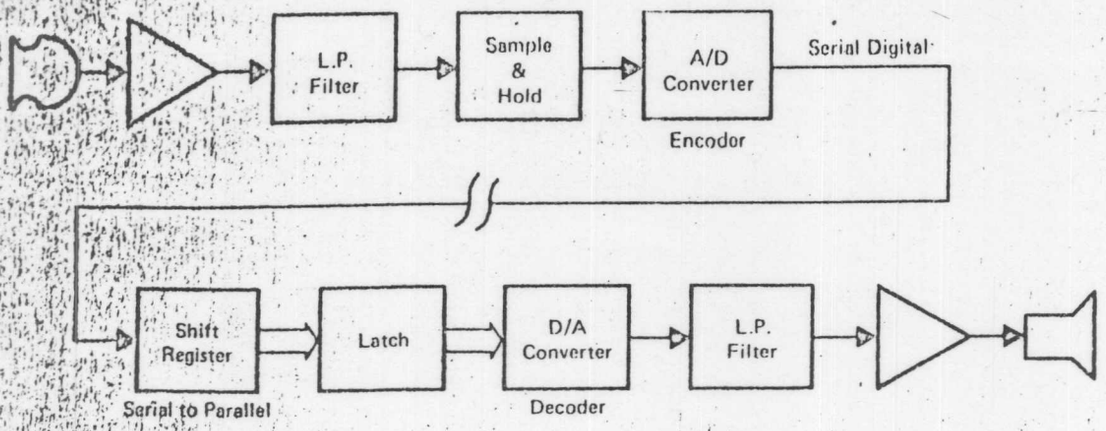
Although, in general, digitized voice requires greater bandwidth for transmission than the voice one, it has a number of important advantages:

1. Far less susceptible to noise interference during transmission.
2. Many channels can be easily multiplexed on a single wideband channel with inexpensive digital hardware. Crosstalk between channels is much lower.
3. Encryption for secure communications is much easier.

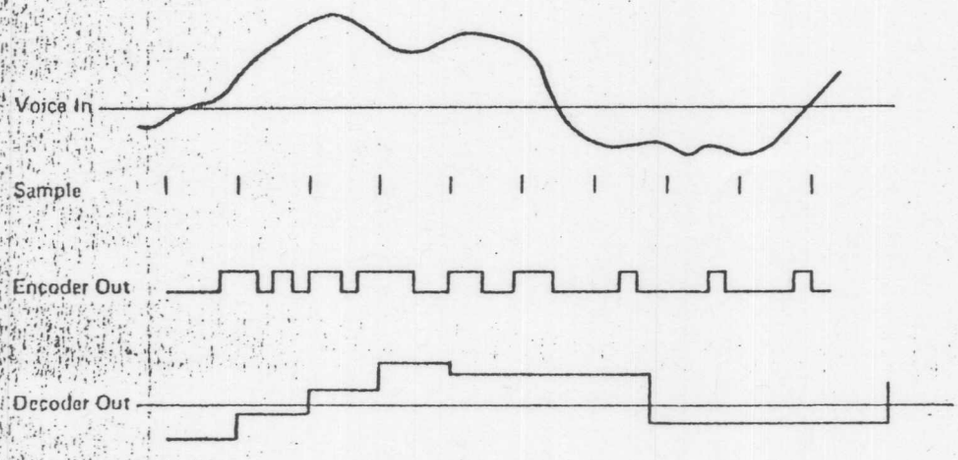
Is CVSD Different from Straightforward A to D & D to A PCM Transmission?

Yes. Both types of systems can be used effectively to digitize voice, but the digitizing schemes are quite different.

The PCM system should be familiar:



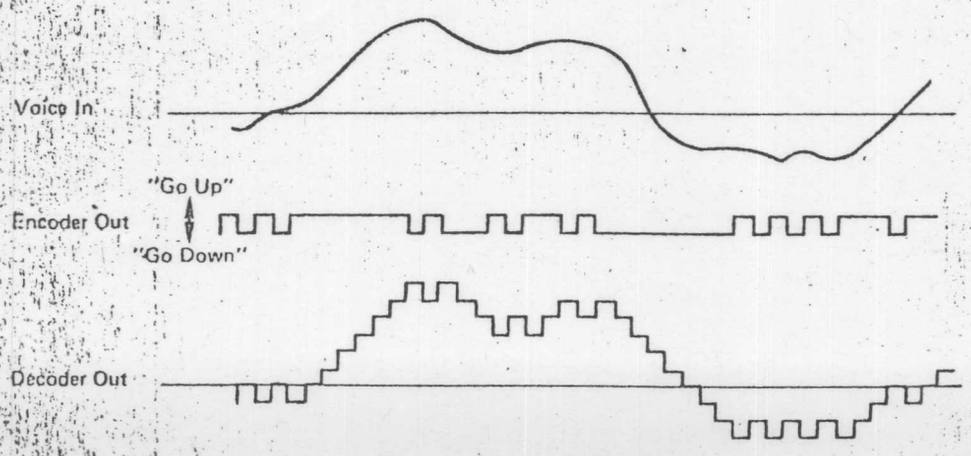
The transmitted data stream consists of a series of "words", each representing the voice signal level at the instant of sampling:



PCM Waveforms

PCM is able to respond to very abrupt level changes between samples, such as an analog signal which has been analog multiplexed.

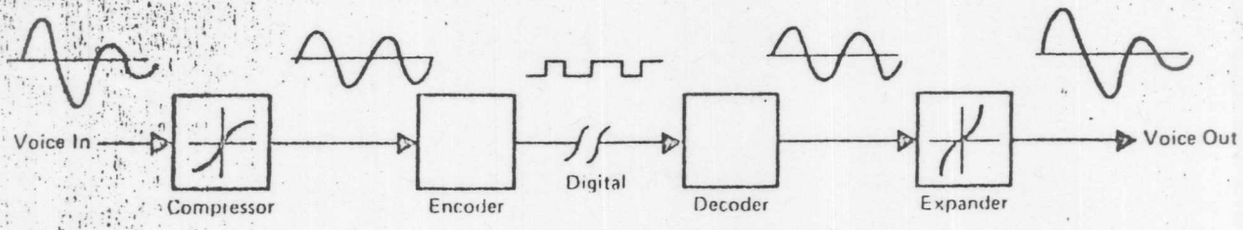
Delta modulation takes advantage of the fact that voice signals do not change abruptly and there is generally only a small change in level from one sample to the next. It is therefore possible to obtain a reasonably good reproduction of the original voice waveform merely by transmitting the information on whether the output needs to go "up" or " down" in a given time interval:



What is Continuously Variable Slope?

Simple delta modulation as described above works best on voice signals which are close to full scale input to the modulator; very low level signals will be severely distorted.

However, excellent voice transmission quality can be obtained by combining delta modulation with "companding" (compressing-expanding) of the voice input and output. Low level signals are given increased gain during modulation, then restored to their proper relative levels during demodulation. CVSD is a companding scheme which is optimized for the characteristics of human voice.



Simplified Companding

How Does CVSD Compare with PCM for Voice Transmission?

1. CVSD allows lower data rates, and consequently more channels to be multiplexed together at the same bit rate. The companded PCM used in standard U.S. telephone systems requires a sample rate of 8,000 samples per second and 8 bits per sample, which equals 64K bits per second per channel. Using CVSD, equal or better transmission quality is obtained at 32K bits per second; meaning that twice as many channels could be multiplexed on the same transmission medium.

2. CVSD exhibits less serious degradation in the presence of digital noise interference. In PCM, a noise induced error in one of the more significant bits in a digital word will give the listener a painful audio transient. In CVSD, an error in any bit produces only a minor transient noise. It has been demonstrated that CVSD transmissions are quite intelligible even with 10% random bit errors introduced.

What is the Advantage of an All-Digital CVSD?

A linear/digital CVSD encoder/decoder can be fairly easily and inexpensively constructed with 4 or 5 standard I.C.'s, about 12 precision resistors, 2 trimmer pots, and 2 precision foil capacitors. The digital CVSD can replace all of these with a single I.C. package, requiring no initial or periodic adjustments, and includes added features such as automatic noise squelch during quiet intervals and a signal usable for automatic gain control. In addition, power, weight and size requirements are greatly reduced.

Who are the Potential Users of CVSD?

CVSD has been selected for military communications. Tactical communications systems use 16K bits per second which, while there is noticible distortion and background hiss, has excellent intelligibility. For higher level military communications a 32K bits per second data rate is used, which yields speech quality comparable to standard telephone transmissions.

Commercial telephone systems presently use a PCM standard for digitized voice transmission, since the perfection of CVSD is a relatively recent accomplishment. However, the great advantages of CVSD in doubling channel capacity and reducing hardware costs make it a strong contender for future systems. It is particularly well suited to microwave, satellite, and optical (laser and light pipe) communications systems.

In digital data transmission systems, CVSD could be used for multiplexing a supervisory voice channel in the digital data. CVSD also has possibilities as an I/O device to a computer for voiceprint identification, waveform analysis, speech command inputs and synthesized speech response.

CVSD also has future potential in commercial radio communications such as police, taxicab, and marine use, where a number of channels could be multiplexed, and each receiver would demultiplex only messages addressed to it. Voice and data for displays or printers could be intermixed, and security provisions to prevent unauthorized reception could be added.

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